Remarks

Drawing

The drawing was objected to because the figures were hand-drawn and illegible. A new set of formal drawings accompanies this response.

Accordingly, it is respectfully submitted that the grounds for this objection have been removed.

Amendments

Claims 1-27 remain in the application for reexamination.

Independent claim 1 has been amended, without prejudice, to improve its clarity and to more adequately protect Applicants' invention. More specifically, the amendments include the following changes:

(1) lines 1-2: the optical router routes *optical signals to a plurality of output channels*; Support is found in FIG. 1, for example, which shows that optical signals λ_{1a} and λ_{2b} are routed from output port 26 of frequency router 20 to output channels 38 and 40, respectively.

(2) line 4: each optical signal contains *destination information.* Support is found in the specification, for example, at page 2, lines 5-8 and page 4, lines 10-11.

(3) lines 7-8: *at least one output port couples routed optical signals to a plurality of output channels.* Support is found in FIG. 1, for example, which shows that optical signals λ_{1a} and λ_{2b} are routed from output port 26 of frequency router 20 to output channels 38 and 40, respectively.

(4) lines 1, 9-10: the optical router is *dynamic* in that *each optical signal to be frequency routed is dynamically tuned to a particular color in response to its destination information.* Although the term *dynamic* is not used explicitly in the application, the dynamic nature of the router would be obvious to one of ordinary skill in the art from the description, which states, for example, that *Each optical signal, as converted, is "colored" in response to the intended destination information* (page 4, lines 10-11) and *Each converter comprises a tunable laser for generating a carrier monochromatic light beam having...a color selected in response to a received packet of data* (page 7, lines 21-22, as to FIG. 3; similar language is found at page 10, lines 1-3 as to FIG. 4). Consequently, it is respectfully submitted that the adjective *dynamic* is supported by the description in the application.

Dependent claims 5 and 13 have been amended, without prejudice, to correct the antecedent problem created by the use of the term *converter*, which should have read *router.*

Independent claims 9 and 14 have been amended to make the following changes:

(1) Line 1 of both claims, line 16 of claim 9,and lines 16-17, 36-37 of claim 14: the

optical router is *dynamic* in that each optical signal to be frequency routed is dynamically tuned to a particular color in response to its destination information. Support for these changes is discussed in paragraph (1) above regarding claim 1 and is incorporated herein by reference.

(2) Lines 2 of both claims: The optical router routes a plurality of packets of data *to a plurality of output channels*. Support is found in FIG. 2, for example, where signals are routed to output channels 164-168. Similar support is found in FIGs. 4-5.

(3) Line 5 of both claims and line 18 of claim 14: The converters provide optical signals to be *combined* and routed. The combiners are recited in claim 9, line 8 and are designated by numerals 112-116 in FIG. 3, with the combining function performed by combiners 118. Similarly, the combiners are also recited in claim 14, lines 8 and 26 and are designated by numerals 218, 250 in FIG. 4 and by 318, 356 in FIG. 5.

(4) Lines 14-15 of both claims, and lines 33-34 of claim 14: The frequency router is designed with *at least one output port coupling routed optical signals to a plurality of output channels*. Support is found in FIG. 3, for example, where output ports 140 of AWG 120 are coupled via receivers 150 to output channels 164-168. Similar support is found in FIGs. 4-5.

(5) Lines 17-19 of claim 9 and lines 21-22 of claim 14: The receivers have *a plurality of outputs corresponding to said output channels, which in turn correspond to intended destinations.* Support is found in FIG. 3, for example, where the outputs of receivers 150 are coupled to output channels 164-168. The description is replete with references that support that notion that routing is based on destination information, as discussed in several instances above. Similarly, the converter 500 of FIG. 7 has a buffer 510, which is responsive to scheduler 525 and hence to destination information (specification, page 4, lines 23-24).

(6) Lines 21-23 of claim 9: The splitters split at least two optical signals *along separate paths toward at least two output channels*, and *a receiver in one path* is tuned to pass one of the at least two routed optical signals to an intended destination. Support is found in FIG. 3, for example, where receivers 150 include power splitters that split (i.e., replicate) the incoming signal along M paths, with the tuning function being performed by tunable filters 154-160 in each path.

Dependent claim 20 has been amended to indicate that *each second stage converter, in response to destination information, re-colors the optical signals that are received thereby.* Support is found in FIG. 4 and 5 and in the specification at page 10, lines 26-28.

Independent method claims 21 and 22 have been amended, without prejudice, as follows:

(1) Lines 1-2 of both claims: The optical signals are routed *to a plurality of output channels*. Support is found in FIG. 1, for example, which shows that optical signals λ_{1a} and λ_{2b} are routed from output port 26 of frequency router 20 to output channels 38 and 40, respectively.

(2) Lines 17-18 of claim 21 and lines 10-11 of claim 22: The routed optical signals are coupled *from at least one output port to a plurality of output channels.* Support is

found in FIG. 1, for example, which shows that optical signals λ_{1a} and λ_{2b} are routed from output port 26 of frequency router 20 to output channels 38 and 40, respectively.

(3) Line 3 of claim 22: To provide proper antecedents the terms *inputs* and *outputs* have been changed to *input ports* and *output ports*, respectively.

(4) Line 5 of claim 22: The preposition *to* has been changed to *at* to improve the clarity of the claim.

(5) Line 8 of claim 22: The preposition *from* has been changed to *at* to improve the clarity of the claim.

Dependent claim 23, line 1, has been amended, without prejudice, to clarify the order of the presenting and processing steps.

Dependent claim 24 has been amended, without prejudice, to clarify the relationship between the coloring step and the input ports.

Inasmuch as each of the foregoing amendments is supported by the specification and/or drawing, or is merely matter of clarification or form, it should be clear that no new matter has been added.

Summary of Applicants' Invention

Before discussing the rejection on the merits, it will be helpful to briefly review Applicants' invention. In accordance with one aspect of the invention, as set forth in claim 1, as amended, a dynamic optical router (e.g., 10) utilizes a uniquely designed frequency router (e.g., 20) to route optical signals to a plurality of output channels (e.g., 38, 40, 42, 44). The frequency router (e.g., 20) has a plurality of input ports (e.g., 22, 24) and a plurality of output ports (e.g., 26, 28), characterized in that:

(1) each optical signal contains destination information,
(2) at least one input port simultaneously receives at least two optical signals (e.g., λ_{1a}, λ_{2a}) to be frequency routed,
(3) at least one output port simultaneously presents at least two frequency routed optical signals (e.g., λ_{1a}, λ_{2b}), and
(4) at least one output port (e.g., 26) couples routed optical signals to a plurality of output channels (e.g., 38, 40),
(5) wherein each optical signal to be frequency routed is dynamically tuned to a particular color in response to its destination information.

In accordance with another aspect of our invention, claims 21, 22 and 25, as amended, set forth a corresponding method of routing a plurality of optical signals to a plurality of output channels.

35 USC 103 Rejection of Claims 1-4 and 21-27

Claims 1-4 and 21-27 have been rejected under 35 USC 103(a) as being unpatentable over Kaminow *et al.*, US Patent No. 5,623,356 (hereinafter *Kaminow*) in view of Glance *et al.* US Patent No. 5,455,699 (hereinafter *Glance*). This rejection is respectfully traversed. The Examiner states his position as follows. (For clarity each of the Examiner's assertions have been listed in separately numbered paragraphs.)

> Re claims(s) 1, 3, 22, 24, 25 and 27 Kaminow disclosed,
> (1) An optical router comprising
> (2) at least one frequency router (Figure 1) having a plurality of input ports ($101_1 - 101_N$) and a plurality of output ports ($127_1 - 127_N$),
> (3) at least one input port simultaneously receives at least two optical signals to be frequency routed (e.g., col./line(s): 2/55-60), and
> (4) at least one output port simultaneously presenting at least two frequency routed optical signals (e.g., col./line(s): 3/60-65),
> (5) Kaminow did not disclose wherein each optical signal to be frequency routed is colored in response to destination information.
> (6) Glance disclosed a frequency router where each optical signal to be frequency routed is colored in response to destination information (e.g., col./line(s): 2/44-47, 3/45-50).
> (7) It would have been obvious…[to] route according to destination for the benefit [of] building a large-capacity packet network that are (*sic*) optically transparent between input and output ports as disclosed by Glance (see e.g., col./line(s): 1/20-25).

The Examiner's argument suggests that the only difference between Kaminow and Applicants' invention is that Kaminow fails to disclose that each optical signal to be frequency routed is colored in response to destination information (paragraph 5, above). In addition, the Examiner suggests that Glance supplies this deficiency (paragraphs 6-7, above).

To the contrary, however, claim 1, as amended, specifically requires three things: (1) lines 4-6: at least one input port (e.g., 22) of frequency router 20 *simultaneously* receives *at least two* optical signals (e.g., λ_{1a} and λ_{2a}) to be frequency routed, (2) lines 6-7: at least one output port (e.g., 26) *simultaneously* presents *at least two* frequency routed optical signals (e.g., λ_{1a} and λ_{2b}), and (3) lines 7-8: at least one output port (e.g., 26) couples routed optical signals to a plurality of output channels (e.g., 38 and 40). In contrast, in Kaminow, and in the combination of Kaminow and Glance, Applicants' type of frequency router, in which at least two optical signals are simultaneously received at an input port and simultaneously presented at an output port, is not even remotely suggested. More specifically, in Kaminow each input port of the wavelength router (FIG. 2, wavelength router 202; col. 4, lines 47-48) receives only a *single* optical signal. Likewise, the wavelength switches 111, which contain wavelength routers 202, receive *single* optical signals on each input port and transmit *single* optical signals at each output port. In no case does Kaminow show, teach or reasonably suggest that more than one optical signal is simultaneously received by any input port of wavelength router 202. Likewise, in Kaminow

each output port of wavelength router 202 presents only a *single* optical signal. In no case does Kaminow show, teach or reasonably suggest that more than one optical signal is simultaneously presented by any output port of wavelength router 202.

Thus, the Kaminow frequency router is essentially made of N wavelength switches 111_N in combination with N space switches 117_N, but, as discussed earlier, at least two of the router inputs (at 107_N) and at least two of the outputs (at 117_N) are not received or presented by the router simultaneously.

In addition, in Kaminow the N WDM signals on input links 101_N in combination with 1 x F Demuxes 105_N do not perform any routing function. Rather, they merely disaggregate WDM traffic coming from the network into separate signals 107_F. Specifically, the wavelengths of the signals on links 101_N are not dynamically tuned in response to destination information, contrary to claim 1, lines 9-10.

Similarly, in the combination of Kaminow and Glance, the only modification of Kaminow suggested by the Examiner is to route Kaminow's packets according to destination information as taught by Glance. But, even if this modification is assumed to be proper, the combination of Kaminow and Glance would not rectify the deficiencies of Kaminow noted above.

First, this conclusion is buttressed by the fact that the frequency router 1 of Glance (FIG. 1) also receives a *single* optical signal at each of its input ports and delivers a *single* optical signal at each of its output ports. See, also, col. 1, lines 65-67 where Glance suggests that his architecture utilizes *a single optical receiver per output port* and col. 2, lines 46-49 where Glance states that *contention... is resolved by allowing one packet at a time to access to the exit fiber*.

Second, the section of Glance cited by the Examiner must be carefully read: col. 2, lines 44-46 state the following:

> The packets are routed by the frequency router according to their wavelengths, with each source using a different wavelength to access a given destination.

Notice that the first clause of the above-quoted sentence of Glance says that packets are routed *according to their wavelengths*; it does *not* say, however, that packets are routed according to *destination information contained within the packets*, as required by Applicants' claim 1. Moreover, the second clause of the above-quoted sentence corroborates this conclusion by correlating wavelength with destination, but it does *not* explain *where the destination information is located.*

Accordingly, it is respectfully submitted that claim 1 is not rendered obvious by the proposed combination of Kaminow and Glance.

On the other hand, claim 2, which depends from claim 1, is patentable over the proposed combination of Kaminow and Glance not only by virtue of its dependence from claim 1 for the reasons discussed above, but also because this claim does not call for general combiners and receivers, but rather calls for specific devices that operate to combine/separate *the at least two routed optical signals*. Since the antecedent for these signals is the at least two signals simultaneously received by an input port, and presented by an output port, of the frequency router, it should be clear that any combiners and the receivers of the Kaminow-Glance combination would not be designed to combine/receive at least two signals simultaneously, as required by claim 2.

Claim 4, which depends from claims 2 and 3, is patentable over the proposed combination of Kaminow and Glance for the reasons set forth above in conjunction with claims 1-3 and incorporated herein by reference, but also because it specifically calls for a converter to be coupled to each combiner in order to color at least one data packet in accordance with destination information. This combiner-converter combination is not reasonably suggested by the cited prior art.

In a similar fashion independent method claims 21, 22 and 25 are patentably distinguishable over the proposed combination of Kaminow and Glance. More specifically, each of these method claims requires that at least two optical signals to be routed are simultaneously received at an input port of a frequency router and at least two routed optical signals are simultaneously presented at an output port of the frequency router. See, claim 21, lines 13-18; claim 22, lines 5-11; and claim 25, lines 7-11. Accordingly, for the reasons set forth for claim 1, above, claims 21, 22 and 25 are not rendered obvious by the combination of Kaminow and Glance.

On the other hand, dependent method claims 23 and 26 are patentable not only by virtue of its dependence from independent claims 22 and 25, respectively, but also because claim 23 specifically requires that each of the at least two signals presented at an output port of the frequency router be further *processed* (*removed*, in the case of claim 26). First, the combination of Kaminow and Glance fails to present two signals simultaneously/concurrently at an output port of the frequency router for the reasons set forth above and incorporated herein by reference, and moreover the combination of these references does not further process the *simultaneously* (*concurrently*, in the case of claim 26) presented signals.

Likewise, dependent method claims 24 and 27 are patentable not only by virtue of their dependence from independent claims 22 and 25, respectively, but also because claims 24 and 26 specifically require that each optical signal is colored, not only as a function of destination information, but also as a further function of which input port it is applied to. This feature is not even remotely suggested by the proposed combination of Kaminow and Glance.

Accordingly, it is respectfully submitted that method claims 21-27 are not rendered obvious by the proposed combination of Kaminow and Glance.

35 USC 103 Rejection of Claim 5

Claim 5 has been rejected under 35 USC 103(a) as being unpatentable over Kaminow and Glance as applied to claim 4 above, and further in view of Wang *et al.*, US Patent No. 5,745,612 (hereinafter *Wang*). This rejection is respectfully traversed. The Examiner states his position as follows. (For clarity each of the Examiner's assertions have been listed in separately numbered paragraphs.)

> Re claim 5, Kaminow further disclosed
> (1) at least one input waveguide (Figure 1#101_1);
> (2) at least one output waveguide (Figure 1#101_N; *sic*, 127_N);
> (3) a first (Figure 1#117_1) and a second free space region (Figure 1 #117_F), the first free space region coupled with the at least one input waveguide and the second free space region coupled with the at least one output waveguide (127).
> (4) Kaminow and Glance do not disclose optical grating having a plurality of unequal length waveguides, each unequal length waveguide coupled between the first free space region and the second free space region.
> (5) However, Wang (Figure 1) disclosed AWG (111 and 112) coupled in such a manner.
> (6) It would be obvious ...to use Wang's AWGs for the benefit [of] removing on-chip waveguide crossing, overlapping) and therefore reducing signal loss (e.g., col./line(s): 2/64-67, 3/1-5)

Applicants' respectfully submit that claim 5 is patentable by virtue of its dependence from claims 1-4 for the reasons set forth above and incorporated herein by reference.

35 USC 103 Rejection of Claims 5, 6 and 9-13

Claims 5, 6 and 9-13 have been rejected under 35 USC 103(a) as being unpatentable over Kaminow and Glance as applied to claim 4 above, and further in view of Brock *et al.*, US Patent No. 5,870,216 (hereinafter *Brock*). This rejection is respectfully traversed. The Examiner states his position as follows. (For clarity each of the Examiner's assertions have been listed in separately numbered paragraphs.)

> Re claim 5, Kaminow further disclosed
> (1) at least one input waveguide (Figure 1#101_1);
> (2) at least one output waveguide (Figure 1#101_N; *sic*, 127_N);
> (3) a first (Figure 1#117_1) and a second free space region (Figure 1 #117_F), the first free space region coupled with the at least one input waveguide and the second free space region coupled with the at least one output waveguide (127).
> (4) Kaminow and Glance do not disclose optical grating having a plurality of unequal length waveguides, each unequal length waveguide coupled between the first free space region and the second free space region.
> (5) However, Brock (Figure 7) disclosed AWG (126 and 128) coupled in such a manner.
> (6) It would have been obvious...to use Brock's AWGs for the benefit [of] removing

reducing signal loss associated with discrete components.

Applicants' respectfully submit that claim 5 is patentable by virtue of its dependence from claims 1-4 for the reasons set forth above and incorporated herein by reference.

The Examiner's position on the purported obviousness of claims 6 and 9 is stated as follows:

> Re claim(s) 6 and 9, In the modified invention as taught
> (1) Glance disclosed the at least two tunable filters (Figure 1#3);
> (2) However, Kaminow and Glance do not disclose at least one splitter for splitting the at least two routed optical signals between the at least two tunable filters such that at least one of the at least two tunable filters is tuned to pass one of the at least two routed optical signals to an intended destination.
> (3) However, Brock disclosed splitters (Figure 2B#70) in a wavelength router.
> (4) It would have been obvious...to use Brock's splitters for the benefit of obtaining broadcast capability (e.g., col./line: 2/35-40).

First, we note for accuracy that claim 9 does not recite tunable filters. That feature is found in claim 5 and in claim 10, which depends from claim 9. Therefore, as to claim 9, paragraph (1) above is moot.

Second, we note that the explicit purpose of Brock is *not* to use splitters. See, for example, Brock's title (*Splitterless Optical Broadcast Switch*) and col. 9, lines 5-10 (which clearly states that his invention *eliminates the use of splitters, such as splitters 70 and 90...*). Thus, contrary to the Examiner's assertion that one skilled in the art would be motivated to use Brock's splitters 70 of FIG. 2B in the Kaminow-Glance combination, Brock in fact *teaches away* from such a modification since his objective is eliminate splitters altogether.

Third, even if the proposed combination of Kaminow, Glance and Brock were proper, the resulting router would not render obvious Applicants' claims 6 or 9 since the splitters 70 of Brock's FIG. 2 follow the power combiner 64 (FIG. 2A; see the continuation onto FIG. 2B) and do not follow a frequency router. This conclusion is corroborated by the fact that in Brock's FIGs. 3 and 4 the splitters 90 (FIG. 4) are part of an *Optical Power Divider...* " 88 (FIG. 3), and, as such, they are *in front of* optical switches; they do not *follow* frequency routers as required by claim 6, lines 3-4 and claim 9, lines 20-21. More specifically, each of these claims recites *at least one splitter for splitting the at least two routed optical signals*. Since Applicants' splitter operates on the *routed* signals, it must follow the frequency router, which performs the routing function.

Fourth, claim 9 recites a specific combination of converters, combiners, frequency routers, receivers and splitters, which is neither taught nor reasonably suggested by the combination of Kaminow, Glance and Brock.

Claim 10, on the other hand, is patentable not only by virtue of its dependence from claim 9 for the reasons discussed above and incorporated herein by reference, but also because it recites a specific combination of tunable light sources within the converters and tunable filter within the receivers, which is not reasonably suggested either by Glance's tunable lasers 6 (FIG. 1; col. 2, lines 35-40) or by Brock's tunable lasers 122 (FIG.7). In neither instance are these tunable lasers used to color optical signals in accordance with destination information contained within data packets.

Claim 11 is patentable not only by virtue of its dependence from claims 9-10 for the reasons discussed above and incorporated herein by reference, but also because it specifically requires *a tunable light source…for coloring the one optical signal in response to destination information* and further requires *a tunable filter for tuning to a color to pass one of the at least two routed optical signals to an intended destination.* The cited art fails to reasonably suggest this nexus between color and destination information, when the latter is contained within the packet itself. Likewise, the cited art fails to reasonably suggest a receiver that passes one of the *at least two routed optical signals*, when the two routed signals were *presented simultaneously* at an output port of the frequency router, as required by the parent claims.

Regarding the claim 12, the Examiner asserts that *In the modified invention as taught, Kaminow disclosed a packet selector or "scheduler" (Glance, Figure 2 #16, e.g. col./line: 2/65-67, 3/1-15).* This rejection is respectfully traversed. Claim 12 is patentable not only by virtue of its dependence from claims 9-11 for the reasons discussed above and incorporated herein by reference, but also because Glance's selector 16, which is part of an optical filter 3, serves a very narrow function – to block all but one packet from exiting filter 3 (FIG. 2) at the same time. In contrast, Applicants' claimed scheduler controls both the converters and the tunable filters (claim 12, lines 2-3).

Claim 13 is patentable by virtue of its dependence from claims 9-11 for the reasons discussed above and incorporated herein by reference.

Allowable Subject Matter

Applicants hereby acknowledge and gratefully appreciate that the Examiner has allowed claims 14-20 and has indicated that claims 7-8 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

In view of the foregoing, reconsideration of claims 1-27, and passage of this application to issue, are hereby respectfully requested. If during the consideration of this paper, the Commissioner believes that resolution of the issues raised will be facilitated by further discussion, he is urged to contact the undersigned attorney at 610-691-7710 (voice) or 610-691-8434 (fax).

Respectfully,

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